Relative laboratory volatility of Dicamba in closed dome systems with buffering agent

Report:	MRID 51279701. Wanner, U. 2020. Volatilization Assessment for Dicamba formulations BAS 183 35H and BAS 183 22H by Quantitative Humidome Set-Up. Unpublished study performed by Symbiotic Research LLC-Subsidiary of Tentamus GmbH, Mount Olive, New Jersey, and Genesis Midwest Laboratories, Neillsville, Wisconsin, and sponsored and submitted by BASF, Research Triangle Park, North Carolina. Symbiotic Research Report No.: SR20200820A and Study No.: 00208. Genesis Midwest Laboratory Code: H-210-002. BASF Registration Document No. (DocID): 2020/294839. Experiment initiated on March 23, 2020 and terminated August 24, 2020 (p. 13). Final report issued August 28, 2020.
Document No.:	MRID 51279701
Guideline:	Non-guideline
Statements:	The study was not conducted in compliance with U.S. EPA FIFRA (40 CFR Part 160) Good Laboratory Practice (GLP) standards, which are compatible with OECD GLP standards. Signed and dated GLP Compliance, Quality Assurance, Data Confidentiality, and Certification of Authenticity statement statements were provided (pp. 2-5).
Classification:	This study is **supplemental, non-guideline**. Test substance storage was not reported. The test soil was only partially characterized, with 50% of the soil as Redi-Earth, a soil with a large amount of sphagnum peat moss, which would make it very high in organic carbon. Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not absolute. The method was not validated at the LOQ.
PC Code:	100094 (Dicamba BAPMA)

Final EPA Reviewer:	Chuck Peck Senior Fate Scientist	**Signature:** **Date:**	2020.10.22 13:44:57 -04'00'
Final EPA Reviewer:	William P. Eckel, Ph.D. Senior Advisor	**Signature:** **Date:**	Digitally signed by William P. Eckel Date: 2020.10.23 10:45:17 -04'00'

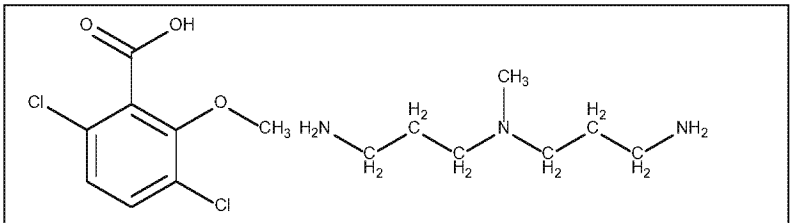
Executive Summary

In a laboratory study, the relative dicamba volatility of Engenia® was investigated on partially characterized soil (50% sandy loam soil and 50% Redi-Earth & Seedling Potting Mix) under aerobic soil conditions for a period of *ca*. 24 hours with various tank mixes (Powermax and Liberty) and varied temperatures (30-35°C and 40-45°C) at ambient relative humidity (*ca*. 40%).

Soil samples were treated at a target application rate of *ca*. 0.56 kg a.e./ha (0.5 lb a.e. dicamba/A). Four replicates for each test condition were examined in the study. Mixed Cellulose Ester (MCE) filter samples were collected for 24 hours after application at a target flow rate of 2.00 ± 0.10 L/minute. The MCE samples were extracted using methanol then centrifuged or filtered to eliminate precipitate, and dicamba was quantitated using LC-MS/MS. No analyses of dicamba in soil were performed. The mass of dicamba collected on the sorbent material was generated for each replicate.

A comparison of the tank mixes with Engenia with (BAS 183 35H) and without a buffering agent indicated that, for the two temperature ranges and the two tank mix products (Powermax and

Liberty), tank mixes with the buffering agent had less volatilization than those without the buffering agent. It should be noted, though, that when the temperature increases to 40-45°C, the emissions with the buffering agent are comparable to the emissions of the tank mix without the buffer at 30-35°C. Also, there does not appear to be any benefit to adding the buffering agent when Engenia is applied by itself.



Dicamba BAPMA [Dicamba -N,N-Bis(3-aminopropyl)methylamine]

I. Material and Methods

A. Materials

1. Test Materials

Table 1a. Properties of Test Materials

Property	Engenia®	BAS 183 35H	Xtendimax with VaporGrip	Roundup PowerMAX®	Liberty
Formulation Type	SL formulation (former code No. 183 WB H), nominal content dicamba (a.e.) 600 g/L	SL formulation nominal content dicamba (acid equivalent) 427.0 g(AE)/L	Water soluble formulation (SL) nominal content dicamba (acid equivalent) 350 g(AE)/L	Not specified	SL formulation
Typical end-use product?	Yes	Yes	Yes	Yes	Yes
Function	Herbicide	Herbicide	Herbicide	Herbicide	Herbicide
Active ingredient	Dicamba (a.e.): 604.4 g/L	Dicamba (a.e.): 427 g/L	Dicamba (a.e.): 350 g/L	540 g/L Glyphosate (as potassium salt)	280 g/L Glufosinate (as ammonium salt)
Manufacture #	Not reported				
Batch ID	7195N01DD	1824-1	MZXM010508	MNZT1020AJ	GNMG490160 GNMG490187
CAS #	1918-00-9 (dicamba) 105-83-9 (BAPMA)	1918-00-9 (dicamba) 105-83-9 (BAPMA)	1918-00-9 (dicamba) 104040-79-1 (DGA)	1071-83-6 (glyphosate)	77182-82-2 (glufosinate)

Data obtained from pp. 13-16 of the study report.

2. Storage Conditions

Test substance storage was not reported.

3. Soil

A characterization of the soils used in the study is provided in **Table 2**. According to ASTM STP1587, on which the humidome studies are based, in order to minimize variability due to the soil composition, a one to one mixture of field soil and Redi-Earth was used. Although different soil types may impact volatility, the use of this standard soil mixture was selected to help reduce the impact of the variability of soil content. According to information obtained from the Internet

(http://www.sungro.com/professional-product/sunshine-redi-earth-plug-seedling/), Redi-Earth is a mixture of fine sphagnum peat moss, dolomite lime, and vermiculite, which is an indication that the mixture contains a high level of organic carbon.

Table 2. Soil(s) Collection, Storage and Properties

Property	Sandy loam soil	Redi-Earth & Seedling Potting Mix[1]
Geographic location	Not reported	
Pesticide use history at the collection site	Not reported	
Collection date	Not reported	
Collection procedures	Not reported	
Sampling depth	Not reported	
Storage conditions	Not reported	
Storage duration	Not reported	
Soil preparation	50% sandy loam soil and 50% Redi-Earth & Seedling Potting Mix (ca. 1 kg)	
Soil texture (USDA):	Sandy loam	
% Sand	77	Not reported
% Silt	14	Not reported
% Clay	9	Not reported
pH (water)	Not reported	Not reported
pH	6.5	Not reported
Organic carbon (%)[2]	3.49	Not reported
Organic matter (%)	6.0	Not reported
CEC (meq/100 g)	10.1	Not reported
Soil Moisture Content (%):	*ca.* 20% (target)	
At 0.1 bar (pF 2.0)	Not reported	
At 1/3 bar (pF 2.5)	14.5	
Bulk density (g/cm^3)	Not reported	
Microbial biomass:		
At initiation	Not reported	
At termination	Not reported	
Soil taxonomic classification (WRB)	Not reported	

Data obtained from Appendix 9, p. 86 of the study report.
1. Characterized as a 55-65% Canadian Sphagnum peat mixed with vermiculite, dolomite lime and wetting agents
2. Reviewer calculated as: organic carbon (%) = organic matter (%)/1.72.

B. Study Design

1. Experimental Conditions

Closed dome systems (humidomes; Hummert International Humid-Dome clear plastic, Item # 143851000) were configured to capture vapor phase dicamba on plastic cassettes filled with "Mixed Cellulose Ester" (MCE) filters following the application of the tank mixtures to the soil (pp. 17). The humidomes were disposable, plastic, sealed containers that allow for controlled environmental conditions and were modified to allow dicamba sample collection on the MCE filters. Assembled, closed humidomes (10" wide x 20" long) were placed in a temperature and humidity controlled environmental chamber.

On each humidome lid, two holes (*ca.* 1 cm) were punched in the middle of each of the smaller sides of the plastic lid. One of the holes was left open, to allow for air intake, while the other hole was plugged with a threaded barbed panel mount and nut. Air exiting the panel mount entered the SKC

filter cartridge with MCE filter. The air left the cartridge, via chemical-resistant Tygon® tubing towards "hovering-ball" airflow meter/adjusters. The airflow was created via a vacuum pump which was attached to the manifold that held six individual airflow adjusters.

Airflow was monitored via a Mesalabs DryCal Defender 520 airflow meter at the beginning and the end of the volatilization period (pp. 17). Chamber lights (LED) were programmed to be on for 14 hours and off for 10 hours. Light intensity was not reported, but wavelength was between 460-660 nm. Automated temperature and relative humidity recorders were employed, but the model information was not specified. After *ca*. 24 hours, the MCE samples were removed from the lid of the humidome and the humidome was removed from the environmental chamber.
Additional experimental design features are provided in **Table 3**.

Table 3. Experimental Design

Parameter		Tank mixes
Duration of the test (hours)		*ca*. 24 for each test
Soil condition (Air dried/fresh)		*ca*. 20% (target moisture)
Soil sample weight (g/replicate)		*ca* 1 kg
Soil depth (cm)		Not reported
Test concentration (mg ai/kg soil (dry weight))		7.23 mg dicamba/kg (target)
Field Equivalent Application Rate (lb a.i./A)		*ca*. 0.5 lb a.e. dicamba/A [15 gallons per acre (GPA) equivalent to 0.5 lb a.e. dicamba/A and 7.23 mg dicamba a.e. per 10" × 20" humidome tray]
Number of replicates		4 for each of the tank mixes
Test apparatus		Closed dome systems (humidomes) configured to capture dicamba on MCE filters.
Test material application	Test solution volume used/ treatment	1.81 mL (spray solution) per tray (target)
	Application method	Sprayer equipped with commercial spray jet and a conveyer with adjustable speed to put the trays on. After application, humidome lid was secured onto tray.
Indication of test material adsorbing to walls of test apparatus?		No
Experimental conditions	Temperature (°C)	30-35°C and 40-45°C
	Relative humidity	40%
	Soil moisture content	20% (target)
	Moisture maintenance method	Not reported
	Air flow through system	2 ± 0.10 L/minute (target; individual values not reported)[1]
	Continuous darkness (Yes/No):	No; 14-hour day light cycle.

Data obtained from pp. 17-20.

2. Sampling during Study Period

After 24 hours, the vacuum pump was turned off, and the MCE filter cartridges were removed, plugged with plastic pins, and immediately placed into a freezer (temperature not reported; p. 20).

No soil samples were collected.

Table 4. Sampling Design

Parameter	Description
Air Sampling	
Sample intervals (hrs)	*ca.* 24
Sampling method	MCE filters in plastic cassettes
Desired air flow of sampler (L/min)	2.00 ± 0.10 L/minute (target; individual values not reported)[1]
Sample storage before analysis (Yes/No)?	Stored frozen (temperature not reported) until shipment for analysis (storage time not reported). Shipped frozen (on dry ice or similar) to analytical lab (Symbiotic Research). After receipt at analytical lab, samples were stored frozen (temperature not reported) and analyzed as soon as possible.

Data obtained from pp. 20 of the study report.

3. Sample Handling and Storage Stability

After collection, samples were removed from the humidomes, immediately placed into a freezer (temperature not reported; p. 20). Samples were shipped frozen (on dry ice or similar) from Genesis Midwest Laboratories, Wisconsin, to the analytical lab (Symbiotic Research, New Jersey). After receipt at analytical lab, samples were stored frozen (temperature not reported) and analyzed as soon as possible (p. 28).

4. Analytical Procedures

Extraction methods: MCE filters were extracted using 100% methanol as the extraction solvent. The methanol dissolves the MCE filter during the extraction process. The caps were removed from the styrene cassettes holding the MCE filters, and the cassette was securely tightened by hand. The plunger was removed from a 25-mL polypropylene syringe, and the syringe was attached to the inlet on the top of the filter cassette. The inlet on the bottom of the cassette was positioned over a labeled, 2-oz amber jar. Methanol, 20 mL, was then added to a volumetric flask. The methanol was poured from the volumetric flask into the polypropylene syringe. The syringe was tapped lightly by hand until the cassette filled with methanol, at which point methanol began to drip at a steady rate (~1 drop per second) from the bottom of the cassette into the amber collection jar. For compatibility with the LC-MS/MS method, the extracts were diluted with water and formic acid. Aliquots of each extract, 0.200 mL, were transferred to 2-mL HPLC vials. HPLC-grade water, 0.790 mL, and 0.010 mL formic acid were added to the extract. These diluted extracts were then allowed to sit at room temperature for ~1 hour. During this time, the formation of particulates was observed in the vials. After approximately 1 hour, each diluted extract was filtered using PVDF syringe filters (0.22-µm pore size, 13 mm diameter) into a 2-mL HPLC vial. The extracts were then analyzed by the validated LC-MS/MS method for the quantification of dicamba (p. 23).

Identification and Quantification of Parent Compound: Aliquots of the methanol extracts were analyzed for dicamba using LC-MS/MS under the following conditions (pp. 27-28):

HPLC	Hewlett Packard 1100 Series
Mass Spectrometer	Sciex API 4000
Data Software	Absciex Analyst 1.4.2
Column	Zorbax Eclipse Plus Phenyl-Hexyl (2.1 × 150 mm, 3.5 µm)
Mobile Phase	A: Water:formic acid (1000:1, v:v)

B: Methanol: acetonirtile (50:50, v:v) with 0.1% formic acid

Normal LC Pressure

Time (minutes)	% A	% B	Flow Rate (mL/min.)
0.0	80	20	0.600
0.5	80	20	0.600
4.0	40	60	0.600
5.0	20	80	0.600
6.0	0	100	0.600
6.5	0	100	0.600
6.7	80	20	0.600
10.0	80	20	0.600

Column Temperature	50°C
Autosampler Temp	Not reported
Injection Volume	Not reported
Ionization Mode	ESI, negative ion mode
Curtain Gas	Not reported
Collision Gas	Not reported
Ion Spray Voltage	Not reported
Source Temperature	Not reported
Ion Source Gas 1	Not reported
Ion Source Gas 2	Not reported
Interface Heater	Not reported
Probe Position	Not reported
MRM Transitions	218.8/174.5 Da (Dicamba)
Declustering Potential	Not reported
Entrance Potential	Not reported
Collision Energy	Not reported
Collision Cell Exit Potential	Not reported

Detection Limits (LOD, LOQ) for the Parent Compound: The limit of quantitation (LOQ) of 10 ng/MCE filter and 0.1 ng/mL (p. 28). The LOD was set to 5 ng/MCE filter and 0.05 ng/mL.

Detection Limits (LOD, LOQ) for the Transformation Products: No transformation products were evaluated in the study.

Instrument performance: A calibration curve based on calibration standards at concentration levels of 0.2-10 ng/mL for dicamba was calculated (pp. 25). Control MCE methanol extracts were used to prepared calibration standards.

Lab recovery, air sampling sorbent material: Average overall recoveries were reported as *ca.* 89% (n=12) for MCE filters fortified with 5,000 and 50,000 ng/mL of dicamba (individual values not reported; p. 27). No samples were prepared at the LOQ of the method.

Lab recovery, soils: Not applicable

II. Results and Discussion

The mass of dicamba and study conditions at a constant air flow rate of 2 L/min SPLM after *ca.* 24 hours are shown in **Table 5**.

Table 5. Volatility of dicamba from soil after *ca.* 24 hours

Formulation/mix	Humidome ID	Temperature Range (C)	Actual Temperature (C)	Relative Humidity (%)	pH of solution	Dicamba Filter (ng/MCE)
Engenia®	ENG_Temp(30-35)-1	30-35	31	47.9	6.5-7.0	11.4
Engenia®	ENG_Temp(30-35)-2	30-35	31	47.9	6.5-7.0	17.5
Engenia®	ENG_Temp(30-35)-3	30-35	31	47.9	6.5-7.0	23.7
Engenia®	ENG_Temp(30-35)-4	30-35	31	47.9	6.5-7.0	16.9
Engenia®	ENG_Temp(30-35)-B-1	30-35	29.7	51.8	6.5-7.0	72.9
Engenia®	ENG_Temp(30-35)-B-2	30-35	29.7	51.8	6.5-7.0	69.7
Engenia®	ENG_Temp(30-35)-B-3	30-35	29.7	51.8	6.5-7.0	47.9
Engenia®	ENG_Temp(30-35)-B-4	30-35	29.7	51.8	6.5-7.0	82.5
BAS 183 35H	18335H_Temp(30-35)-1	30-35	31.5	44.8	8.2-8.8	24.8
BAS 183 35H	18335H_Temp(30-35)-2	30-35	31.5	44.8	8.2-8.8	30.5
BAS 183 35H	18335H_Temp(30-35)-3	30-35	31.5	44.8	8.2-8.8	33.5
BAS 183 35H	18335H_Temp(30-35)-4	30-35	31.5	44.8	8.2-8.8	47.5
BAS 183 35H[1]	18335H_Temp(30-35)-B-1	30-35	29.4	53.3	8.2-8.8	814
BAS 183 35H	18335H_Temp(30-35)-B-2	30-35	29.4	53.3	8.2-8.8	90.7
BAS 183 35H	18335H_Temp(30-35)-B-3	30-35	29.4	53.3	8.2-8.8	72.5
BAS 183 35H	18335H_Temp(30-35)-B-4	30-35	29.4	53.3	8.2-8.8	68.2
Xtendimax®	XTEN_Temp(30-35)-1	30-35	29.6	42.2	5.8-6.7	15
Xtendimax®	XTEN_Temp(30-35)-2	30-35	29.6	42.2	5.8-6.7	24.4
Xtendimax®	XTEN_Temp(30-35)-3	30-35	29.6	42.2	5.8-6.7	0
Xtendimax®	XTEN_Temp(30-35)-4	30-35	29.6	42.2	5.8-6.7	40.3
Xtendimax®	XTEN_Temp(30-35)-B-1	30-35	29.4	53.3	5.8-6.7	142
Xtendimax®	XTEN_Temp(30-35)-B-2	30-35	29.4	53.3	5.8-6.7	122
Xtendimax®	XTEN_Temp(30-35)-B-3	30-35	29.4	53.3	5.8-6.7	49
Xtendimax®	XTEN_Temp(30-35)-B-4	30-35	29.4	53.3	5.8-6.7	41.5
Engenia® + Powermax®	ENG_POW_Temp(30-35)-1	30-35	29.4	51.7	4.7-4.9	375
Engenia® + Powermax®	ENG_POW_Temp(30-35)-2	30-35	29.4	51.7	4.7-4.9	378
Engenia® + Powermax®	ENG_POW_Temp(30-35)-3	30-35	29.4	51.7	4.7-4.9	486
Engenia® + Powermax®	ENG_POW_Temp(30-35)-4	30-35	29.4	51.7	4.7-4.9	282
Engenia® + Powermax®	ENG_POW_Temp(30-35)-B-1	30-35	31.1	43.2	4.7-4.9	87.3
Engenia® + Powermax®	ENG_POW_Temp(30-35)-B-2	30-35	31.1	43.2	4.7-4.9	520
Engenia® + Powermax®	ENG_POW_Temp(30-35)-B-3	30-35	31.1	43.2	4.7-4.9	49.2

Formulation/mix	Humidome ID	Temperature Range (C)	Actual Temperature (C)	Relative Humidity (%)	pH of solution	Dicamba Filter (ng/MCE)
Engenia® + Powermax®	ENG_POW_Temp(30-35)-B-4	30-35	31.1	43.2	4.7-4.9	393
BAS 183 35H + Powermax®	18335H_POW_Temp(30-35)-B-1	30-35	31.2	42.9	5.5-5.7	99.2
BAS 183 35H + Powermax®	18335H_POW_Temp(30-35)-B-1	30-35	31.2	42.9	5.5-5.7	51.4
BAS 183 35H + Powermax®	18335H_POW_Temp(30-35)-B-1	30-35	31.2	42.9	5.5-5.7	34.1
BAS 183 35H + Powermax®	18335H_POW_Temp(30-35)-B-1	30-35	31.2	42.9	5.5-5.7	76.7
Xtendimax® + Powermax®	XTEN_POW_Temp(30-35)-B-1	30-35	31.5	41.2	4.7-5.0	99.6
Xtendimax® + Powermax®	XTEN_POW_Temp(30-35)-B-2	30-35	31.5	41.2	4.7-5.0	138
Xtendimax® + Powermax®	XTEN_POW_Temp(30-35)-B-3	30-35	31.5	41.2	4.7-5.0	111
Xtendimax® + Powermax®	XTEN_POW_Temp(30-35)-B-4	30-35	31.5	41.2	4.7-5.0	46.1
Engenia® + Powermax®	ENG_POW_Temp(40-45)-B-1	40-45	42.5	48.6	4.6-4.9	1250
Engenia® + Powermax®	ENG_POW_Temp(40-45)-B-2	40-45	42.5	48.6	4.6-4.9	1220
Engenia® + Powermax®	ENG_POW_Temp(40-45)-B-3	40-45	42.5	48.6	4.6-4.9	679
Engenia® + Powermax®	ENG_POW_Temp(40-45)-B-4	40-45	42.5	48.6	4.6-4.9	1310
BAS 183 35H + Powermax®	18335H_POW_Temp(40-45)-B-1	40-45	40.6	42.6	5.3-5.7	286
BAS 183 35H + Powermax®	18335H_POW_Temp(40-45)-B-2	40-45	40.6	42.6	5.3-5.7	329
BAS 183 35H + Powermax®	18335H_POW_Temp(40-45)-B-3	40-45	40.6	42.6	5.3-5.7	225
BAS 183 35H + Powermax®	18335H_POW_Temp(40-45)-B-4	40-45	40.6	42.6	5.3-5.7	230
Xtendimax® + Powermax®	XTEN_POW_Temp(40-45)-1	40-45	39.1	40.2	4.8-5.1	558
Xtendimax® + Powermax®	XTEN_POW_Temp(40-45)-2	40-45	39.1	40.2	4.8-5.1	404
Xtendimax® + Powermax®	XTEN_POW_Temp(40-45)-3	40-45	39.1	40.2	4.8-5.1	570
Xtendimax® + Powermax®	XTEN_POW_Temp(40-45)-4	40-45	39.1	40.2	4.8-5.1	692
Engenia® + Liberty®	ENG_LIB_Temp(30-35)-1	30-35	29.3	42.8	6.8-7.5	71.8
Engenia® + Liberty®	ENG_LIB_Temp(30-35)-2	30-35	29.3	42.8	6.8-7.5	126
Engenia® + Liberty®	ENG_LIB_Temp(30-35)-3	30-35	29.3	42.8	6.8-7.5	105
Engenia® + Liberty®	ENG_LIB_Temp(30-35)-4	30-35	29.3	42.8	6.8-7.5	54.9
BAS 183 35H + Liberty®	18335H_LIB_Temp(30-35)-1	30-35	29.5	44.1	8.3-8.7	31
BAS 183 35H + Liberty®	18335H_LIB_Temp(30-35)-2	30-35	29.5	44.1	8.3-8.7	51.9

Formulation/mix	Humidome ID	Temperature Range (C)	Actual Temperature (C)	Relative Humidity (%)	pH of solution	Dicamba Filter (ng/MCE)
BAS 183 35H + Liberty®	18335H_LIB_Temp(30-35)-3	30-35	29.5	44.1	8.3-8.7	54.3
BAS 183 35H + Liberty®	18335H_LIB_Temp(30-35)-4	30-35	29.5	44.1	8.3-8.7	49.9
Engenia® + Liberty®	ENG_LIB_Temp(40-45)-C-1	40-45	38.9	45.3	7.1-7.4	305
Engenia® + Liberty®	ENG_LIB_Temp(40-45)-C-2	40-45	38.9	45.3	7.1-7.4	940
Engenia® + Liberty®	ENG_LIB_Temp(40-45)-C-3	40-45	38.9	45.3	7.1-7.4	325
Engenia® + Liberty®	ENG_LIB_Temp(40-45)-C-4	40-45	38.9	45.3	7.1-7.4	548
BAS 183 35H + Liberty®	18335H_LIB_Temp(40-45)-B-1	40-45	38.9	45.3	8.4-8.7	140
BAS 183 35H + Liberty®	18335H_LIB_Temp(40-45)-B-2	40-45	38.9	45.3	8.4-8.7	140
BAS 183 35H + Liberty®	18335H_LIB_Temp(40-45)-B-3	40-45	38.9	45.3	8.4-8.7	92.6
BAS 183 35H + Liberty®	18335H_LIB_Temp(40-45)-B-4	40-45	38.9	45.3	8.4-8.7	145

1. Study authors concluded that this sample was an outlier and excluded via Student distribution-based assessment (with n-1=7 degrees of freedom and a resulting Student factor of 1.895 at the 99% level)

A comparison of the tank mixes with Engenia with (BAS 183 35H) and without a buffering agent is provided in **Table 6.** For the two temperature ranges and the two tank mix products (Powermax and Liberty), tank mixes with the buffering agent had less volatilization than those without the buffering agent. It should be noted, though, that when the temperature increases to 40-45°C, the emissions with the buffering agent are comparable to the emissions of the tank mix without the buffer at 30-35°C. Also, there does not appear to be any benefit to adding the buffering agent when Engenia is applied by itself.

Table 6. Comparison of Volatility Results with and without Buffering Agent

Temp Range (C)	Tank Mix	Dicamba (ng/PUF)	Tank Mix	Dicamba (ng/PUF)	Percent Reduction
30-35	Engenia®	42.81	BAS 183 35H	52.53	-23%
30-35	Engenia® + Powermax®	321.31	BAS 183 35H + Powermax®	65.35	80%
40-45	Engenia® + Powermax®	1114.75	BAS 183 35H + Powermax®	267.5	76%
30-35	Engenia® + Liberty®	89.43	BAS 183 35H + Liberty®	46.78	48%
40-45	Engenia® + Liberty®	529.5	BAS 183 35H + Liberty®	129.40	76%

III. Study Deficiencies and Reviewer's Comments

1. The test substance storage was not reported.

2. The test soil was only partially characterized. The sandy loam soil was characterized without USDA soil texture classification, and the Redi-Earth & Seedling Potting Mix was not characterized. ASTM protocol STP1587, used in the conduct of this study, requires that "In order to minimize variability due to the soil composition, a one to one mixture of US10 field soil and

Redi-Earth was used. Although different soil types may impact volatility, using this standard soil mixture helped reduce the impact of this variable." Results of this study should not be used quantitatively except for soils with an organic carbon content greater than or equal to that of peat soil. Differences in volatility should be regarded as relative, not as absolute values.

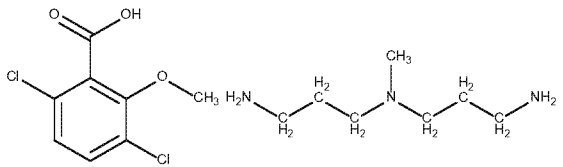
3. Method validation data was incomplete. No samples were prepared at the LOQ of the method.

4. According to study authors, "During the preparation of spray solutions containing both Engenia® and Liberty® 280 SL it was observed that the two aliquots could only be dissolved, by adding previously prepared solutions of Engenia® (aliquot dissolved in ca 750 mL) and Liberty® (aliquot dissolved in ca 200 mL water) together. It was also found essential that prior to mixing those solutions slowly together, that the Engenia® solution was slightly heated and kept stirring, while slowly adding the Liberty® solution to it. After adding both solutions together, the resulting spray solution was kept stirring for an additional 20 minutes." (p.18) Such measures are not reflective of how one would expect applicators to mix these two products in a tank. As such, the combination of these two products does not seem indicative of an appropriate tank mix.

IV. References

1. Gavlick, W.K., Wright, D.R., MacInnes, A., Hemminghaus, J.W., Webb, J.K., Yermolenka, V.I., and Su, W. 2016. "A Method to Determine the Relative Volatility of Auxin Herbicide Formulations," Pesticide Formulation and Delivery Systems: 35th Volume, ASTM STP1587, G.R. Goss, Ed., ASTM International, West Conshohocken, PA, pp. 24-32.

DER ATTACHMENT 1. Dicamba BAPMA and Its Environmental Transformation Products. [A]

Code Name/ Synonym	Chemical Name	Chemical Structure	Study Type	MRID	Maximum %AR (day)	Final %AR (study length)
PARENT						
Dicamba BAPMA (N,N-Bis-(3-aminopropyl)methylamine salt of dicamba; Dicamba-biproamine)	**IUPAC:** 3,6-Dichloro-o-anisic acid - N-(3-aminopropyl)-N-methylpropane-1,3-diamine (1:1) **CAS:** 3,6-Dichloro-2-methoxybenzoic acid compound with N^1-(3-aminopropyl)-N^1-methyl-1,3-propanediamine (1:1) **CAS No.:** 1286239-22-2 **Formula:** $C_{15}H_{25}Cl_2N_3O_3$ **MW:** 366.28 g/mol **SMILES:** NCCCN(C)CCCN.ClC1=CC=C(Cl)C(C(O)=O)=C1OC		Non-guideline	51049001	NA	NA
MAJOR (>10%) TRANSFORMATION PRODUCTS						
No major transformation products were identified.						
MINOR (<10%) TRANSFORMATION PRODUCTS						
No minor transformation products were identified.						
REFERENCE COMPOUNDS NOT IDENTIFIED						
All compounds used as reference compounds were identified.						

[A] AR means "applied radioactivity". MW means "molecular weight". NA means "not applicable".

Attachment 2: Statistics Spreadsheets and Graphs

100094_XXXXXXXX_D
ER-Fate_NG-Humidon